

The Impact of Amazonian Deforestation on Dry Season Rainfall

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(Manuscript received 31 December 2002, in final form 10 October 2003)

ABSTRACT

Many modeling studies have concluded that widespread deforestation of Amazonia would lead to decreased rainfall. Geosynchronous visible and infrared satellite data over southwest Brazil are analyzed with respect to percent cloudiness, and rain estimates are analyzed from both the Tropical Rainfall Measuring Mission and Special Sensor Microwave Imager. The studies conclude that in the dry season, when the effects of the surface are not overwhelmed by synoptic-scale weather disturbances, shallow cumulus cloudiness, deep convective cloudiness, and rainfall occurrence all are larger over the deforested and nonforested (savanna) regions than over areas of dense forest. This paper speculates that this difference is in response to a local circulation initiated by the differential heating of the region's varying forestation. Analysis of the diurnal cycle of cloudiness reveals a shift in the onset of convection toward afternoon hours in the deforested and toward the morning hours in the savanna regions when compared to the neighboring forested regions. Analysis of 14 years of monthly estimates from the Special Sensor Microwave Imager data revealed that in August there was a pattern of higher monthly rainfall amounts over the deforested region. Analysis of available rain gauge data showed an increase in regional rainfall since deforestation began around 1978.

1. Introduction

Initial modeling efforts assessing the impact of Amazonian deforestation assumed widespread deforestation. Nobre et al. (1991) ran simulations using a global spectral model and found that large-scale conversion of forest to pasture decreased the precipitation by 25%. Using the Goddard Global Circulation Model (GCM), Walker et al. (1995) ran a 5-day simulation and showed a decrease in precipitation of 8% in the wettest month of the year. The National Center for Atmospheric Research (NCAR) community climate model results (Hahmann and Dickinson 1997) noted an eastward shift in wet season precipitation with deforestation rather than an overall decrease over the deforested area. More recent modeling work utilized

a mesoscale model with realistic forcing using a "fish-bone" pattern (Wang et al. 2000). This revealed that mesoscale circulations enhanced cloudiness and localized rainfall as well as dry season enhancement of shallow clouds under weak synoptic forcing. Observations and modeling of landscape heterogeneity resulting from differential land use indicated a direct thermal circulation over areas of the Midwest (Weaver and Avissar 2001).

Observations have not borne out the initial modeling studies. Analysis of outgoing longwave radiation (OLR) from 1974 to 1990 and monthly rainfall at Belem and Manaus both showed upward trends in cloudiness and precipitation, despite deforestation in that period (Chu et al. 1994). Using the Global Historical Climatological Network (GHCN) (Easterling et al. 1996) OLR, and National Centers for Environmental Prediction (NCEP) reanalysis, Chen et al. (2001) noted an increasing trend of precipitation over the Amazon Basin. They found clear evidence in the observed global-scale water vapor convergence patterns that more moisture is moving into the Amazon Basin than in the past. They conclude that this inter-

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